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URBANA

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PREGLACIAL EROSION SURFACES IN ILLINOIS

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PREGLACIAL EROSION SURFACES IN ILLINOIS[1]

LELAND HORBERG
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ABSTRACT

A generalized map of buried erosion surfaces in Illinois, compiled from detailed maps of the bedrock topography, provides regional perspective for recognition and correlation of erosion surfaces within the state. A correlation of the Lancaster peneplain of northwestern Illinois, the Calhoun peneplain of western Illinois, and the Ozark peneplain of northern Illinois is suggested; an independent lower surface which developed on the weak rocks of the Illinois basin is described and named the "Central Illinois peneplain"; and possible straths along major preglacial valleys are recognized and named the "Havana strath."

INTRODUCTION

Because of the cover of glacial drift, studies of erosion surfaces in the Mississippi Valley region have been restricted largely to the Driftless Area and to the uplands lying outside the limits of glaciation. Studies in Illinois, which concern (1) the Driftless Area of northwestern Illinois, (2) Calhoun County in western Illinois, and (3) the southern unglaciated section, are summarized briefly in the following pages. A few attempts have been made to correlate buried bedrock uplands in local areas within the glaciated region, but there has been no regional treatment of the problem. In the present study a groundwork for regional interpretation was provided by a detailed bedrock-surface map of Illinois, which was compiled in connection with ground-water studies. A generalized contour map of the erosion surfaces (Fig. 1) summarizes the essential features revealed by the detailed map.

The detailed bedrock-surface map was compiled from about 60,000 records of borings within the state and from all available data on the location of bedrock exposures. In areas where the drift is thin, the present topography, shown by topographic maps, revealed the major features of the bedrock surface. The original maps for about half the state were compiled on topographic sheets and contoured with intervals of 10, 20, and 25 feet. For the remainder of the state, where less control was available, 50-foot contours were drawn on a base map having a scale of 4 miles to the inch. The final map of the entire state was drafted on the latter scale.

The generalized map of the erosion surfaces was drawn from the detailed map by connecting points of equal elevation on interstream areas. It thus shows the general form of the uplands before dissection and could be considered an attempted reconstruction of a late Tertiary land surface somewhat modified by later fluvial and glacial erosion. The element of personal judgment enters into the selection of broad valleys that are to be shown or eliminated, otherwise the contours are closely controlled by numerous points on the divides. This method applied to the upland terraces of southern New England was found to show the same major features as those revealed by multiple projected profiles of the same area.[2]

[1] Published with the permission of the chief of the Illinois Geological Survey, Urbana, Illinois.

[2] George F. Adams, "Upland Terraces in Southern New England," *Jour. Geol.*, Vol. LIII (1945), p. 309.

PREVIOUS STUDIES OF EROSION SURFACES IN ADJOINING DRIFTLESS AREAS

NORTHWESTERN ILLINOIS

The upland surfaces in the Driftless Area of the upper Mississippi Valley have been studied intensively for the last fifty years and are better known than other erosion surfaces in the interior of the continent.[3] Yet there is no general agreement as to the number of cyclical surfaces present or their age. Interpretations have ranged from noncyclical development during a single period of erosion[4] to recognition of five distinct cyclical surfaces.[5] Most writers have identified remnants of either one or two peneplains.

[3] O. H. Hershey, "Preglacial Erosion Cycles in Northwestern Illinois," *Amer. Geol.*, Vol. XVIII (1896), pp. 72–100, and "The Physiographic development of the Upper Mississippi Valley," *ibid.*, Vol. XX (1897), pp. 246–68; U. S. Grant and E. E. Burchard, "Lancaster–Mineral Point Folio, Wisconsin-Iowa-Illinois," *U.S. Geol. Surv. Geol. Atlas, Folio 145* (1907), p. 2; A. C. Trowbridge, "Some Partly Dissected Plains in Jo Daviess County, Illinois," *Jour. Geol.*, Vol. XXI (1913), pp. 731–42; E. W. Shaw and A. C. Trowbridge, "Galena-Elizabeth Folio, Illinois-Iowa," *U.S. Geol. Surv. Geol. Atlas, Folio 200* (1916), pp. 9–10; A. C. Trowbridge and E. W. Shaw, "Geology and Geography of the Galena and Elizabeth Quadrangles," *Ill. Geol. Surv. Bull. 26* (1916), pp. 136–46; U. B. Hughes, "A Correlation of the Peneplains of the Driftless Area," *Proc. Iowa Acad. Sci.*, Vol. XXIII (1916), pp. 125–32; A. C. Trowbridge, "The Erosional History of the Driftless Area," *Iowa Univ. Studies*, 1st ser., No. 40 ("Studies in Nat. Hist.," Vol. IX, No. 3 [1921]), pp. 55–127 (the most detailed study of the problem; contains a complete bibliography up to 1921); Lawrence Martin, "Physical Geography of Wisconsin," *Wis. Geol. Surv. Bull. 36* (2d ed., 1932), pp.69–77; A. C. Trowbridge, in *Kansas Geological Society Guide Book, Ninth Annual Field Conference, Upper Mississippi Valley* (Wichita: Kansas Geological Soc., 1935), pp. 62, 75; F. T. Thwaites, in *Kansas Geological Society Guide Book* . . . . , pp. 105–26; R. E. Bates, "Geomorphic History of the Kickapoo Region, Wisconsin," *Bull. Geol. Soc. Amer.*, Vol. L (1939), pp. 820–41.

[4] Martin, ftn. 3.

[5] Hershey, ftn. 3.

In the Illinois section of the Driftless Area two prominent upland surfaces are present. The upper surface, termed the "Dodgeville peneplain,"[6] is represented by the tops of narrow ridges and isolated mounds capped by Silurian dolomite which are 1,000–1,150 feet above sea-level and 350–450 feet above drainage. The lower surface, called the "Lancaster peneplain,"[7] lies about 200 feet below the Dodgeville plain and is of greater extent than the older surface. It coincides closely with the top of the Ordovician Galena dolomite and slopes southwestward from about 950–800 feet above sea-level (Figs. 3 and 4).[8]

Gravels of the Windrow formation are found on remnants of the Dodgeville peneplain in adjoining states,[9] but only scattered pebbles, occurring at various elevations, have been found in Illinois.[10] Nebraskan drift is reported to be present on both upland surfaces in Iowa but has not been discovered in valleys eroded below the Lancaster plain. This relation led Trowbridge[11] to conclude that the lower surface was undissected at the

[6] Named from the upland near Dodgeville, Wisconsin, by Trowbridge (p. 64 of ftn. 3 [1921]). Trowbridge now regards the Dodgeville plain as part of the lower Lancaster peneplain rather than as an independent erosion surface (personal communication [1946]).

[7] Named from Lancaster, Wisconsin, by Grant and Burchard, p. 2 of ftn. 3.

[8] Both surfaces are well shown on the Galena and Elizabeth quadrangle maps.

[9] R. D. Salisbury, "Preglacial Gravels on the Quartzite Range near Baraboo, Wisconsin," *Jour. Geol.*, Vol. III (1895), pp. 665–67; Trowbridge, pp. 111–13 of ftn. 3 (1921); F. T. Thwaites and W. H. Twenhofel, "Windrow Formation: An Upland Gravel Formation of the Driftless and Adjacent Areas of the Upper Mississippi Valley," *Bull. Geol. Soc. Amer.*, Vol. XXXII (1920), pp. 293–314.

[10] Trowbridge, p. 112 of ftn. 3 (1921); H. B. Willman, personal communication (1946).

[11] Pp. 123–25 of ftn. 3 (1921) and pp. 62, 75 of ftn. 3 (1935).

time of Nebraskan glaciation. However, the possibility of subsequent removal of the drift from the valleys cannot be eliminated altogether, and the surface may have been dissected at an earlier date. This alternative is indicated by the occurrence of Kansan and possibly Nebraskan drift within deep bedrock valleys of the ancient Mississippi and its tributaries (Fig. 5) in the central part of the state.[12] A compromise view that the deep valley of the ancient Mississippi in the Driftless Area is younger than the deep valley to the south has not been supported by preliminary subsurface studies in the intervening area.

CALHOUN COUNTY, WESTERN ILLINOIS

The narrow upland peninsula between the Mississippi and the Illinois rivers above their junction in western Illinois is driftless except for loess deposits, and two erosion surfaces in the area have been described by W. W. Rubey.[13] An upper surface, forming the crest of the upland at an elevation of 700–750 feet, was named the "Calhoun peneplain," and an intermediate level, 125–250 feet lower, was described as a postmature surface (Fig. 1). The Lincoln Hills, in the adjoining area in Missouri, rise 100–200 feet above the higher surface. The higher surface is largely on Osage (Mississippian) limestones, and to the north it bevels structure. Gravels of "Lafayette type," composed of chert, quartz, and quartzite in a ferruginous matrix, are present on the upper surface north of the Cap au Grés faulted flexure and on a lower upland about 600 feet above sea-level south of the flexure in the southern tip of the county (Fig. 1).[14] This relation raises the question of whether there was important movement along the Cap au Grés fault after deposition of the gravels, as concluded by Rubey,[15] or whether gravels, possibly of different age, were deposited on two distinct surfaces.

SOUTHERN ILLINOIS

The driftless section of southern Illinois roughly includes the area lying south of the Pennsylvanian (Caseyville) escarpment, which extends east-west completely across the southern tip of the state (Fig. 1). Within this region there are two important uplands which are structurally and topographically distinct: (1) the Shawnee section, which includes the Pennsylvanian cuesta and adjoining lower surfaces on the south, and (2) an isolated segment of the Salem plateau of the Ozark region margining the Mississippi trench along the west side of the area.[16] The upland surfaces in the Shawnee section occur at several levels, on various bedrock formations which have been extensively faulted and probably include undifferentiated cyclical and structural surfaces. The uplands of the Salem plateau, in contrast, rise to accordant levels about 700 feet above sea-level and are underlain almost exclusively by deeply weathered Devonian cherts.

No detailed studies have been made of the entire district, and attempted cor-

[12] Leland Horberg, "A Major Buried Valley in East-central Illinois and Its Regional Relationships," *Jour. Geol.*, Vol. LIII (1945), pp. 353–55; unpublished sample study records in the files of the Illinois Geological Survey.

[13] "Geology and Mineral Resource of the Hardin-Brussels Quadrangles, Illinois," unpublished manuscript (1931).

[14] Rubey, ftn. 13; R. D. Salisbury, "On the Northward and Eastward Extension of the Pre-Pleistocene Gravels of the Mississippi Basin," *Bull. Geol. Soc. Amer.*, Vol. III (1892), pp. 183–86; Stuart Weller, "Notes on the Geology of Northern Calhoun County," *Ill. Geol. Surv. Bull. 4* (1907), p. 231.

[15] Ftn. 13.

[16] N. M. Fenneman, *Physiography of Eastern United States* (New York: McGraw-Hill Book Co., Inc.. 1938), pp. 438–39, 651–52, Pl. VI.

relation must be based on studies of two local areas and on broad regional relations. As the result of studies by R. D. Salisbury[17] in Hardin County at the eastern edge of the Shawnee Hills, and by J. E. Lamar[18] in the Carbondale quadrangle in the western part, four erosion surfaces ranging in elevation from 500 to 900 feet have been described, as shown by Table 1. The surface 700–760 feet above sea-level, described by Lamar, appears to be most extensive, and it is probably this surface pleted sometime during the Tertiary. It is significant that the Devonian formations of the Salem Plateau have been weathered and leached to depths of about 400 feet and that this unusual depth of alteration has been ascribed by J. M. Weller[22] to a possible prolonged alteration under peneplain conditions.

The generalized contour map of the upland surfaces (Fig. 1) suggests (1) the presence of a widespread surface about 700 feet above sea-level that is correlative with the Ozark peneplain, and (2) re-

TABLE 1

EROSION SURFACES IN SOUTHERN ILLINOIS

HARDIN COUNTY (SALISBURY)		CARBONDALE QUADRANGLE (LAMAR)	
Name	Elev.	Elev.	Name
Present flood plains	320–340	320–350	Present flood plains
Elizabethtown plain	400–420		
McFarlan plain	500–540	500–560	McFarlan plain(?)
Karbers Ridge plain	600–640	600–650	Karbers Ridge plain(?)
		700–760	Unnamed
Buzzards Point plain	860–900	800–860	Buzzards Point plain(?)

which R. F. Flint[19] recognized as part of the domed Ozark peneplain and correlated with the Highland Rim surface in Kentucky and Tennessee, and which N. M. Feneman,[20] in addition, correlated with the Lexington peneplain of Kentucky and the Lancaster peneplain in the Driftless Area. The surface is believed by Flint[21] to transect Wilcox (Eocene) strata and therefore to have been com-

[17] Stuart Weller, Charles Butts, L. W. Currier, and R. D. Salisbury, "Geology of Hardin County," *Ill. Geol. Surv. Bull. 41* (1920), pp. 47–52.

[18] "Geology and Mineral Resources of the Carbondale Quadrangle," *Ill. Geol. Surv. Bull. 48* (1925), pp. 152–54.

[19] "Ozark Segment of Mississippi River," *Jour. Geol.*, Vol. XLIX (1941), pp. 634–36, 640.

[20] Pp. 441, 504, and 660 of ftn. 16.

[21] Pp. 639–40 of ftn. 19.

stricted higher-summit areas which may represent remnants of the Buzzards Point plain or monadnocks on the lower surface. Lower surfaces, 500–550 feet and 600–650 feet in elevation, in the central part of the area may represent the McFarlan and Karbers Ridge plains, respectively, or they may be primarily structural plains.

Lafayette-type gravel occurs on the Salem Plateau in Union County,[23] on the Pennsylvanian escarpment in Gallatin County,[24] and on the crests of hills

[22] "Devonian System in Southern Illinois," *Ill. Geol. Surv. Bull 68A: Devonian Symposium* (1944), pp. 101–2.

[23] J. M. Weller, personal communication (1945).

[24] Charles Butts, "Geology and Mineral Resources of the Equality-Shawneetown Area," *Ill. Geol. Surv. Bull. 47* (1925), p. 52.

and ridges at lower elevations south to the Ohio valley (Fig. 1). Because of the presence of a weathered zone up to 6 feet thick on the Lafayette and below the loess, J. M. Weller[25] has concluded that deposition of Lafayette gravels was followed by a long period of stable conditions, under which weathering progressed, and that the major period of bedrock erosion giving rise to the present topography occurred during the final part of the post-Lafayette preglacial interval.

BURIED EROSION SURFACES

GALENA UPLAND SURFACE

Description.—The summit areas of the preglacial Galena upland in north-central and northwestern Illinois form a remarkably uniform plain, which slopes southeastward from 950 feet above sea-level at the edge of the Driftless Area to about 800 feet at the south edge of the upland (Lancaster peneplain, Fig. 1). The gradient is about 3 feet per mile, and local relief on the restored surface in most places is less than 50 feet. A broad, upland crest, which extends southeastward across the southwestern part of the upland, coincides closely with the preglacial divide between the ancient Mississippi and Rock River drainage systems (Fig. 5). Along the south and east margin of the upland there is a break in upland profiles between elevations of 800 feet on the north and 650 feet on the south. The zone along which the change occurs is about 20 miles wide and is independent of structure. Along it is drawn the boundary between the Lancaster and Central Illinois peneplains (Fig. 1).

Relation to structure.—The upland plain is developed largely on the Galena dolomite, although in only a few places does it coincide closely with the upper part of the formation. Comparison of the generalized bedrock-surface contours with structure contours of similar interval on the top of the Galena (Figs. 1 and 2) shows that in the western half of the upland the rock surface is generally 150 feet or more below the top of the dolomite, and that to the east the surface crosses onto the overlying Maquoketa shale and lies 100 feet or more above the top of the Galena dolomite. In various local areas the surface is eroded on beds ranging in age from Silurian (Niagaran dolomite) to Cambrian (Trempealeau dolomite).

When the structural and topographic trends are compared, a further lack of coincidence is revealed. The regional slope of the upland is roughly S. 30° E., whereas the three major structural trends are north-south along the Wisconsin arch, east-west along the Savanna-Sabula anticline, and N. 60° W. along the positive element between the Sandwich fault zone and the LaSalle anticline (Fig. 2). Locally there are several places where beveling of structure is indicated: (1) across the Savanna-Sabula anticline and the syncline to the north, (2) across the northwest flank of the LaSalle anticline near its juncture with the Savanna-Sabula anticline in southwestern Ogle County (3) across the northern end of the Sandwich fault zone and related structures in southeastern Ogle and northeastern Lee counties, and (4) across numerous minor folds which plunge down regional dip on the east flank of the Wisconsin arch.

It is concluded that there is only a gross relation between structure and the upland surface and that, in detail, the transgressions of structure are so numerous and important that the surface can-

[25] "Geology and Oil Possibilities of Extreme Southern Illinois," *Ill. Geol. Surv. Rept. Investigations 71* (1940), p. 45.

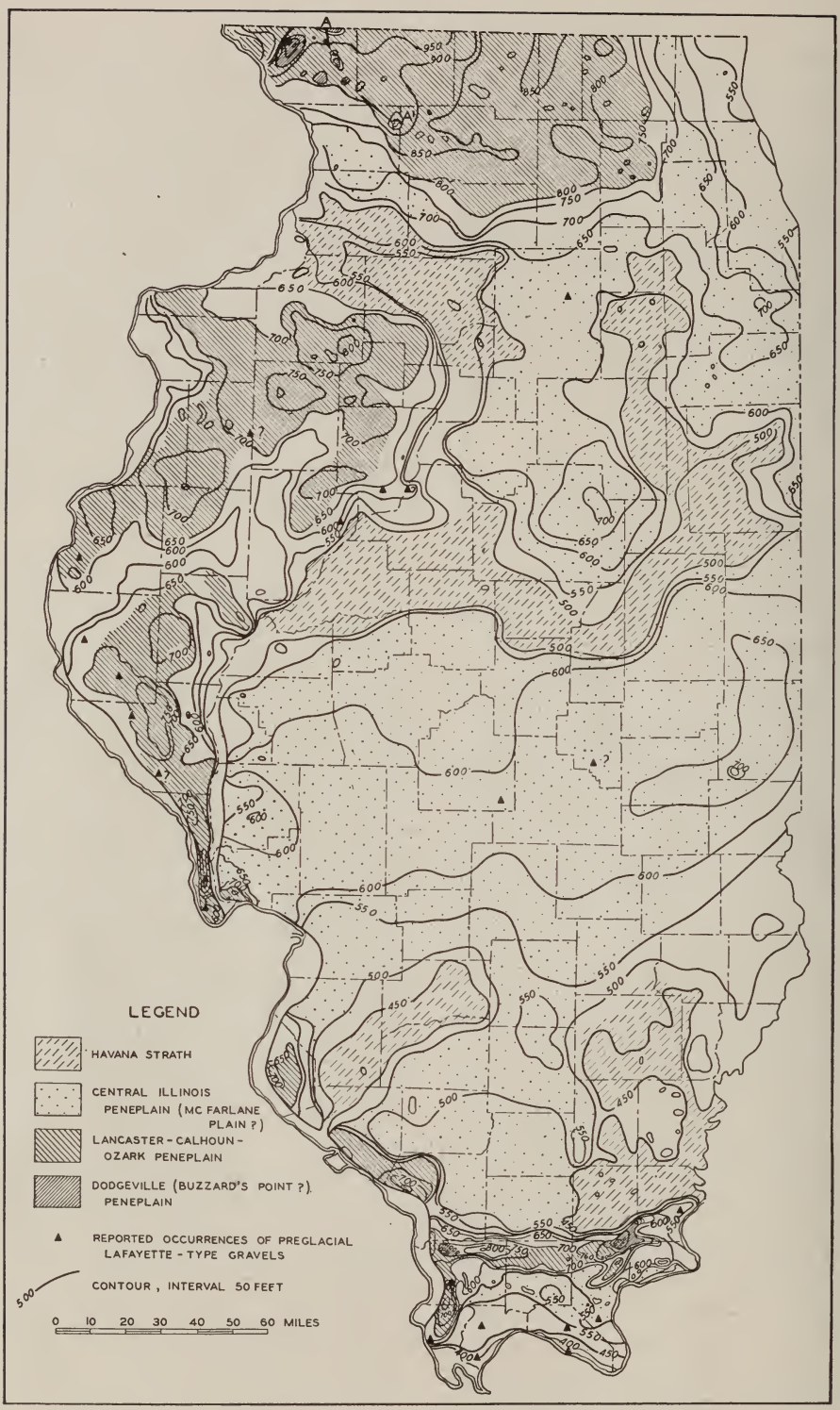

FIG. 1.—Generalized contour map of the erosion surfaces in Illinois

not be considered a simple structure plain.

Correlation.—The Galena upland plain within the drift-covered area was recognized previously[26] and interpreted as modified remnants of what is now generally regarded as the Lancaster or late

of projected profiles in the Driftless Area that the Lancaster peneplain of Trowbridge is a stripped structural plain rather than a cyclical surface. This conclusion appears to be justified by relations in the Illinois section of the Driftless Area, where the Lancaster peneplain

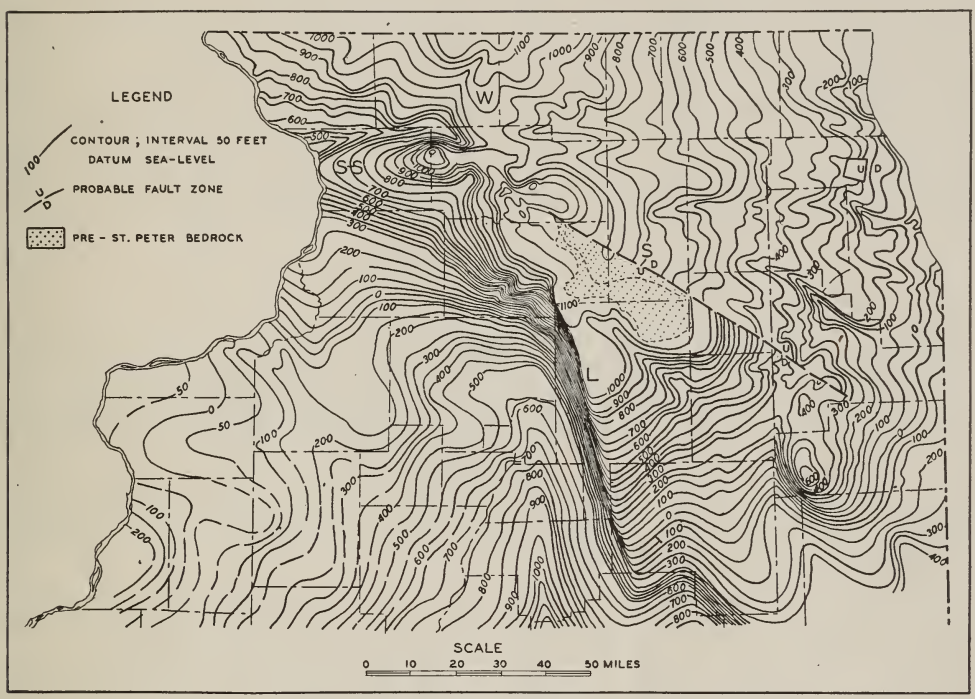

FIG. 2.—Structure contours on top of the Galena dolomite in northern Illinois. *W*, Wisconsin arch; *S-S*, Savanna-Sabula anticline; *S*, Sandwich fault zone; *L*, LaSalle anticline.

Tertiary peneplain. This conclusion is substantiated by the present study.

The alternative—that the surface represents the higher Dodgeville peneplain—is possible if downwarping is postulated; and it is supported indirectly by Bates,[27] who concluded from a study

coincides closely with the top of the Galena dolomite. However, if it is the Lancaster surface that extends southeastward below the drift and bevels structure on the Galena upland, the cyclical origin of the surface finds new support. In fact, one of the strongest evidences of beveling is found just south of the drift margin, where the Maquoketa shale and Silurian dolomite along the syncline north of the Savanna-Sabula anticline are truncated by the bedrock surface (Fig. 3).

[26] Hershey ftn. 3 (1896) (1897); J H. Bretz, "Geology and Mineral Resources of the Kings Quadrangle," *Ill. Geol. Surv. Bull. 43* (1923), pp. 273–77; R. S. Knappen, "Geology and Mineral Resources of the Dixon Quadrangle," *Ill. Geol. Surv. Bull. 49* (1926), pp. 90–93.

[27] Pp. 833–37 of ftn. 3.

In an attempt to determine whether this bedrock surface represents the Lancaster or the Dodgeville surface, a generalized contour map covering most of the Driftless Area in Illinois was constructed from topographic sheets (Fig. 4). The reconstruction indicates (1) that the Dodgeville upland in its northern part is delimited from Lancaster surfaces to the east and west by clearly defined escarpments but that to the south there is no sharp break to a lower surface; (2) that possible isolated remnants of the Dodgeville peneplain in the south half of the Elizabeth quadrangle are distinct from the Lancaster surface on the north but descend more gradually to a lower surface on the south; (3) that the Lancaster surface in the northern half of the Elizabeth quadrangle continues eastward below the drift and possibly southward onto the uplands of the Savanna quadrangle. Relations 1 and 2 suggest the possibility that the Dodgeville peneplain is downwarped to the south and that the Lancaster could be a local southwest-sloping structural plain. However, it appears to be the Lancaster surface which continues eastward into the area where the buried Galena upland surface is best developed (Fig. 1). Because of this, the Galena upland surface is correlated with the Lancaster peneplain.

UPLAND SURFACES IN WESTERN ILLINOIS

Description.—The bedrock uplands in western Illinois are less continuous and more variable in elevation than those of the Galena upland to the north and the Pennsylvanian lowland to the east. They appear to represent a broad, mature surface, on which there are possible remnants of a summit peneplain 700–800 feet above sea-level and possibly a lower surface 600–650 feet above sea-level (Fig. 1). The upper surface is interrupted by two broad valleys, so that it is not continuous from north to south. Possible remnants of the lower surface are present only along the northern and eastern margin of the upland.

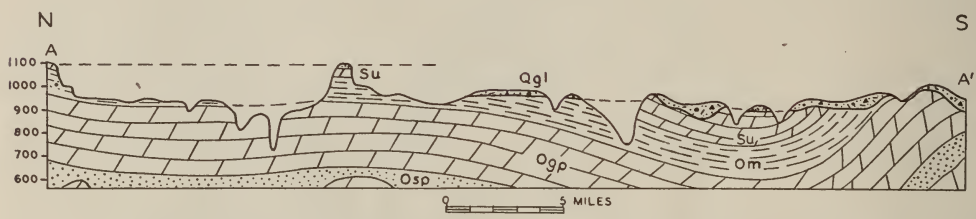

FIG. 3.—Cross-section showing Dodgeville (*upper*) and Lancaster (*lower*) surfaces in northwestern Illinois along *A–A'* of Fig. 1. *Qgl*, glacial drift; *Su*, Silurian dolomite; *Om*, Maquoketa shale; *Ogp*, Galena-Platteville dolomite; *Osp*, St. Peter sandstone.

In the western part of the area the upper surface is continuous from weak Pennsylvanian beds on the east to resistant Mississippian (Meramec and Osage) dolomites to the west. Actually, the highest elevations are on Pennsylvanian strata near the northwest corner of the upland. The high elevation of the upland as a whole compared with the lowland to the east cannot be explained by differential erosion, as there are no important differences in the compositon of the Pennsylvanian rocks in the two areas. Nor is there any marked difference in drainage position, since the higher upland is essentially surrounded by major preglacial valleys. One possible explana-

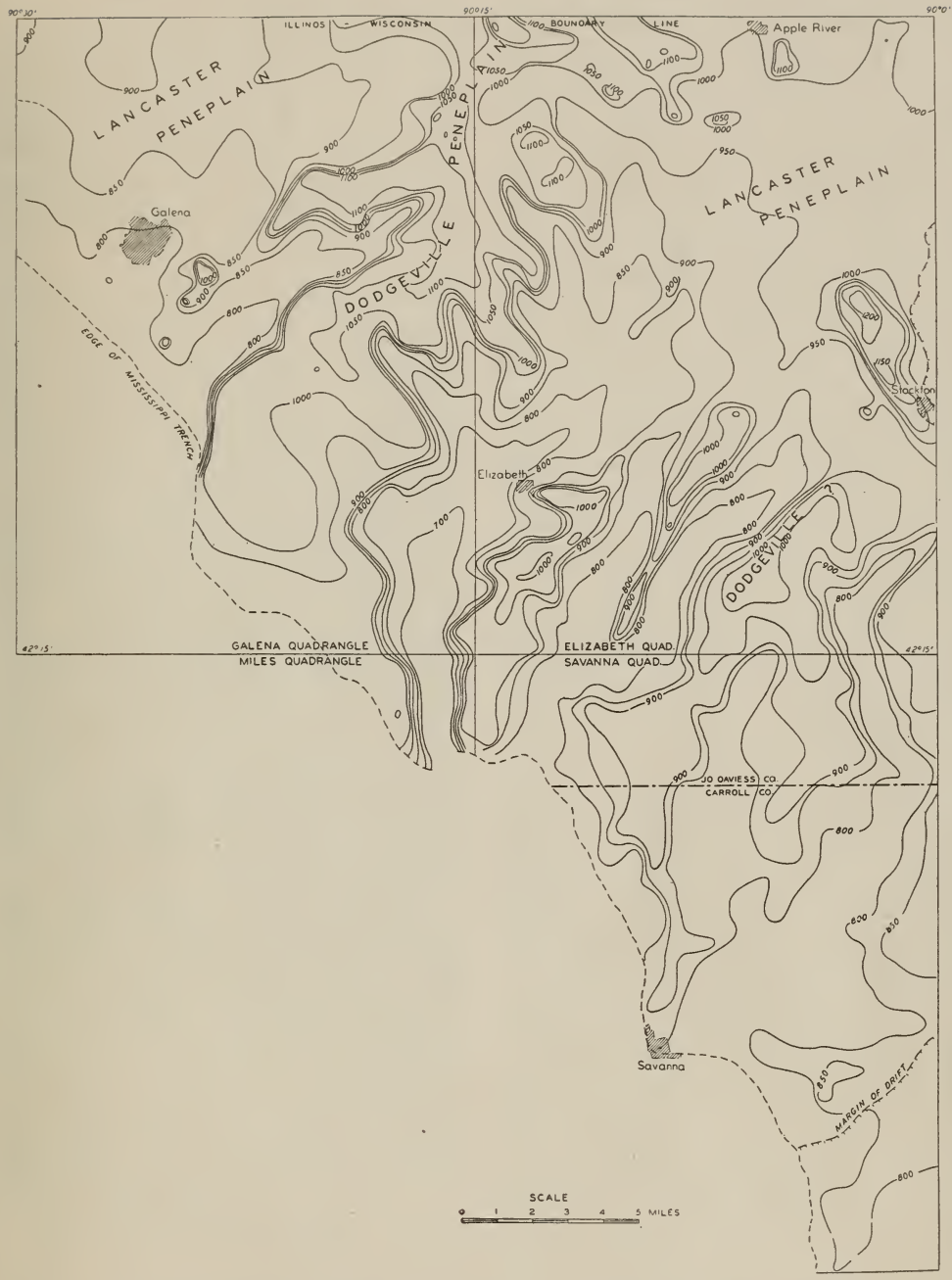

FIG. 4.—Generalized contour map of upland surfaces in the Driftless Area, northwestern Illinois

tion may be found in the higher structural position and diminished thickness of the Pennsylvanian strata to the west, so that resistant Mississippian limestones floor the lower portions of many large bedrock valleys. The local baselevels provided by these resistant beds may have been effective in retarding erosion of the uplands. This explanation, however, would not apply to the northern third of the upland, where Mississippian beds are absent, nor would it explain why erosion of the lower surface to the east was not also retarded by similar local baselevels along its western margin. For these reasons it is believed that structural control was not a major factor and that the escarpment between the two areas represents the junction of a higher and a lower peneplain.

Preglacial gravels of Lafayette type have been reported from Pike, Adams, Hancock, Fulton, Peoria, Tazewell, Warren, Henderson, and possibly Rock Island counties (Fig. 1).[28]

Correlation.—Summit areas in the southern part of the upland are continuous with the Calhoun peneplain of the driftless area of western Illinois described by Rubey[29] and those in the northern part are close to the required level. If the surface is projected northward across the Green River bedrock lowland, which separates the uplands of western Illinois from the Galena upland (Fig. 1), a correlation with the Lancaster peneplain is possible. Lower surfaces along the eastern and northern margins of the upland are probably extensions of the Central Illinois peneplain from the preglacial Pennsylvanian lowland to the east.

[28] A. H. Worthen, "Geology of Hancock County," *Geol. Surv. of Ill.*, Vol. I (1866), p. 330; "Geology of Pike County," *ibid.*, Vol. IV (1870), p. 37; "Geology of Fulton County," *ibid.*, p. 91; H. M. Bannister, "Geology of Tazewell, McLean, Logan, and Menard Counties," *Geol. Surv. of Ill.*, Vol. IV (1870), p. 179. Occurrences in Adams, Henderson, and possibly Rock Island county are reported by R. D. Salisbury in "A Further Note on the Ages of the Orange Sands," *Amer. Jour. Sci.*, Vol. XLII (3d ser., 1891), pp. 252–53, and in ftn. 14. The occurrence in Peoria County was noted by J. A. Udden in "The Geology and Mineral Resources of the Peoria Quadrangle," *U.S. Geol. Surv. Bull. 506* (1912), p. 50, and possible occurrences in southern Pike and eastern Warren counties were reported by J. E. Lamar (personal communication [1945]).

[29] Ftn. 13.

UPLAND SURFACE IN SOUTHWESTERN ILLINOIS

Description.—The bedrock upland northwest of the southern Illinois driftless area in Monroe, Randolph, and Jackson counties is covered by relatively thin drift and forms a prominent feature of the present topography (Fig. 1). A central ridge which rises to a maximum elevation of over 700 feet extends along the length of the upland and is bordered by extensive flattish summit areas. The summit areas have a general elevation of 600–700 feet north of Kaskaskia bedrock valley and 600–650 feet south of the valley. The upland is underlain by Mississippian (Osage, Meramec and Chester) strata and represents a segment of the Salem plateau of the Ozarks isolated by the Mississippi River.

Correlation.—The upland was considered a part of the Ozark topographic dome by R. F. Flint,[30] and on the basis of projected profiles was interpreted as an upwarped peneplain. It thus forms a northward continuation of the Ozark peneplain from the driftless area to the south. Northwestward, the surface appears to continue across the Mississippi River into the St. Louis area[31] and to merge with the Calhoun peneplain of western Illinois.

[30] Pp. 634–36 of ftn. 19.

[31] N. M. Fenneman, "Physiography of the St. Louis Area," *Ill. Geol. Surv. Bull 12* (1909), pp. 52, 57; "Geology and Mineral Resources of the St. Louis Quadrangle, Missouri-Illinois," *U.S. Geol. Surv. Bull. 438* (1911), pp. 43–44.

CENTRAL ILLINOIS PENEPLAIN

Description.—This modified surface is believed to extend over most of the Pennsylvanian lowland and to be widely developed on the Niagara cuesta of northeastern Illinois. It is thus considered the most extensive erosion surface within the state. The surface is unusually uniform in elevation; and, throughout the northern three-quarters of the area, upland elevations in most places lie between the 600- and the 650-foot contours; to the south they descend to about 500 feet (Fig. 1). The highest sections of the upland rise about 100 feet above the general level in the east-central part of the state and form broad crests which conform closely to preglacial drainage divides (Figs. 1 and 5). Small remnants of the surface may be present in the Pennsylvanian upland to the west, as previously noted, and also southwest of the Galena upland in northwestern Illinois.

There is a general coincidence of the surface with the Illinois structural basin, but a general lack of adjustment to local structures. Transection of structure is especially apparent along the LaSalle uplift, which extends northwest-southeast across the northern half of the area (Fig. 2). In the LaSalle region, beds ranging in age from Pennsylvanian to Ordovician (Shakopee dolomite) are beveled by the surface. Further lack of adjustment to structure is indicated by the possible extension of the surface onto the hard rocks of the Niagara cuesta of northeastern Illinois.

Three possible occurrences of preglacial Lafayette-type gravel are known within the area (Fig. 1): (1) on the bedrock upland at Pana, in Christian County, where a thin bed of ferruginous conglomerate with angular and rounded chert pebbles was penetrated at the base of the drift in a diamond-drill boring;[32] (2) near Sullivan, about 30 miles northeast in central Moultrie County, where about 15 feet of ferruginous conglomerate with quartz and chert pebbles, mixed with weathered Pennsylvanian siltstone at the base of the drift, were identified by the writer from well sample cuttings; and (3) near Wedron, in LaSalle County, in the northern part of the area, where 2–4 feet of limonitic conglomerate and sandstone with polished chert pebbles directly overlies the bedrock.[33] The two latter deposits occur below the highest part of the upland at elevations of about 485 and 550 feet, respectively, and may be reworked from a former extensive upland gravel.

Correlation.—The surface is believed to represent a single peneplain developed largely on the weak rocks of the Illinois basin below the level of older erosion surfaces to the north, west, and south. The surface was recognized previously in various parts of southern Illinois[34] and in most cases was ascribed to a "third cycle" of erosion, completed in the Tertiary, following the two cycles represented by upland plains in the driftless areas of southern and northwestern Illinois.[35] In the northern part of the area

[32] Frank Leverett, "The Illinois Glacial Lobe," *U.S. Geol. Surv. Mono. 38* (1899), p. 107.

[33] H. B. Willman and J. N. Payne, "Geology and Mineral Resources of the Marseilles, Ottawa, and Streator Quadrangles," *Ill. Geol. Surv. Bull. 66* (1942), pp. 204–5.

[34] E. W. Shaw and T. E. Savage, "Murphysboro-Herrin Folio, Illinois," *U.S. Geol. Surv. Atlas, Folio 185* (1912), p. 12, and "Tallula-Springfield Folio, Illinois," *U.S. Geol. Surv. Atlas, Folio 188* (1913), p. 10; E. W. Shaw, "New Athens-Okawville Folio, Illinois," *U.S. Geol. Surv. Atlas, Folio 213* (1921), p. 8, and "Carlyle-Centralia Folio, Illinois," *U.S. Geol. Surv. Atlas, Folio 216* (1923), p. 7; Wallace Lee, "Gillespie–Mt. Olive Folio, Illinois," *U.S. Geol. Surv. Atlas, Folio 220* (1926), p. 1.

[35] This is the conclusion of E. W. Shaw and T. E. Savage in ftn. 34 (1912), (1913); and Shaw (1921),

the surface has been clearly identified in LaSalle County and correlated with the Galena upland surface and the Dodgeville peneplain.[36] This correlation is not supported by the present study because of the physiographic discontinuity of the LaSalle County surface with the Galena upland plain and the possibility that the latter is continuous with the Lancaster peneplain rather than with the Dodgeville.

STRATHS ALONG MAJOR PREGLACIAL VALLEYS

A broad-valley stage preceding stream entrenchment is evidenced by possible straths along the preglacial Mahomet (Teays), ancient Mississippi, Kaskaskia, and Wabash drainage systems (Figs. 1 and 5). The existence of these surfaces is interpreted entirely from subsurface data, and they are related only indirectly to the alluvial plains which floor some of these valleys at present. The cyclical origin of some of the surfaces is uncertain because local baselevels and glacial changes may have been important factors in their development. Also, in some places the bedrock surface could not be delineated accurately because of insufficient data. It is significant, however, that the cumulative data indicate rock benches, which seem to descend regularly from 550 feet on the north to 450 feet and less toward the south, and that the valleys are much wider than those resulting from late preglacial entrenchment. Because of these features, an erosion level intermediate between the Central Illinois peneplain and the "deep-stage" valleys is postulated. It is named the "Havana strath" from the extensive bedrock lowland near the junction of the Mahomet (Teays) and ancient Mississippi bedrock valleys.

ENTRENCHED PREGLACIAL VALLEYS

The deep-stage valleys (Fig. 5) are entrenched 100 feet or more below the Havana straths and probably represent the final episode in preglacial erosional history. Although the preglacial age of the upper Mississippi bedrock valley may be open to question, there is evidence that Kansan and, possibly, Nebraskan drift is present in bedrock valleys of the ancient Mississippi, Rock, and Mahomet (Teays) systems, indicating that these valleys, and probably most of the deep bedrock valleys, were eroded to their present depths before the glacial period.

SUMMARY OF EROSIONAL HISTORY

The oldest erosion surface in the state may be represented by remnants of the Dodgeville peneplain in northwestern Illinois and the Buzzards Point plain in southern Illinois. Below these levels the Lancaster-Calhoun-Ozark peneplain appears to have developed as an extensive regional surface in late Tertiary time. Following completion of the peneplain, and probably prior to the making of the central Illinois peneplain, Lafayette-type gravels were spread over its surface,[37] and it appears likely that the positions of

(1923). Wallace Lee (pp. 1, 11 of ftn. 34) correlated the surface with the lower (Lancaster) surface in the Driftless Area and suggested its possible completion in the Mesozoic and uplift in the Tertiary.

[36] Willman and Payne, pp. 204–5 of ftn. 33.

[37] These gravels present numerous unsolved problems. Their age is indefinite "Tertiary," and it is probable that similar deposits of various ages are to be found in the upper Mississippi Valley as well as in the Gulf states. Similarities in composition could be explained by the re-working of an originally widespread deposit or by the repeated access to similar source materials. It is uncertain whether the gravels on the Lancaster-Calhoun-Ozark surface are older than the deposits at lower elevations in central and southern Illinois or whether they are essentially contemporaneous and therefore record important deformation of the peneplain.

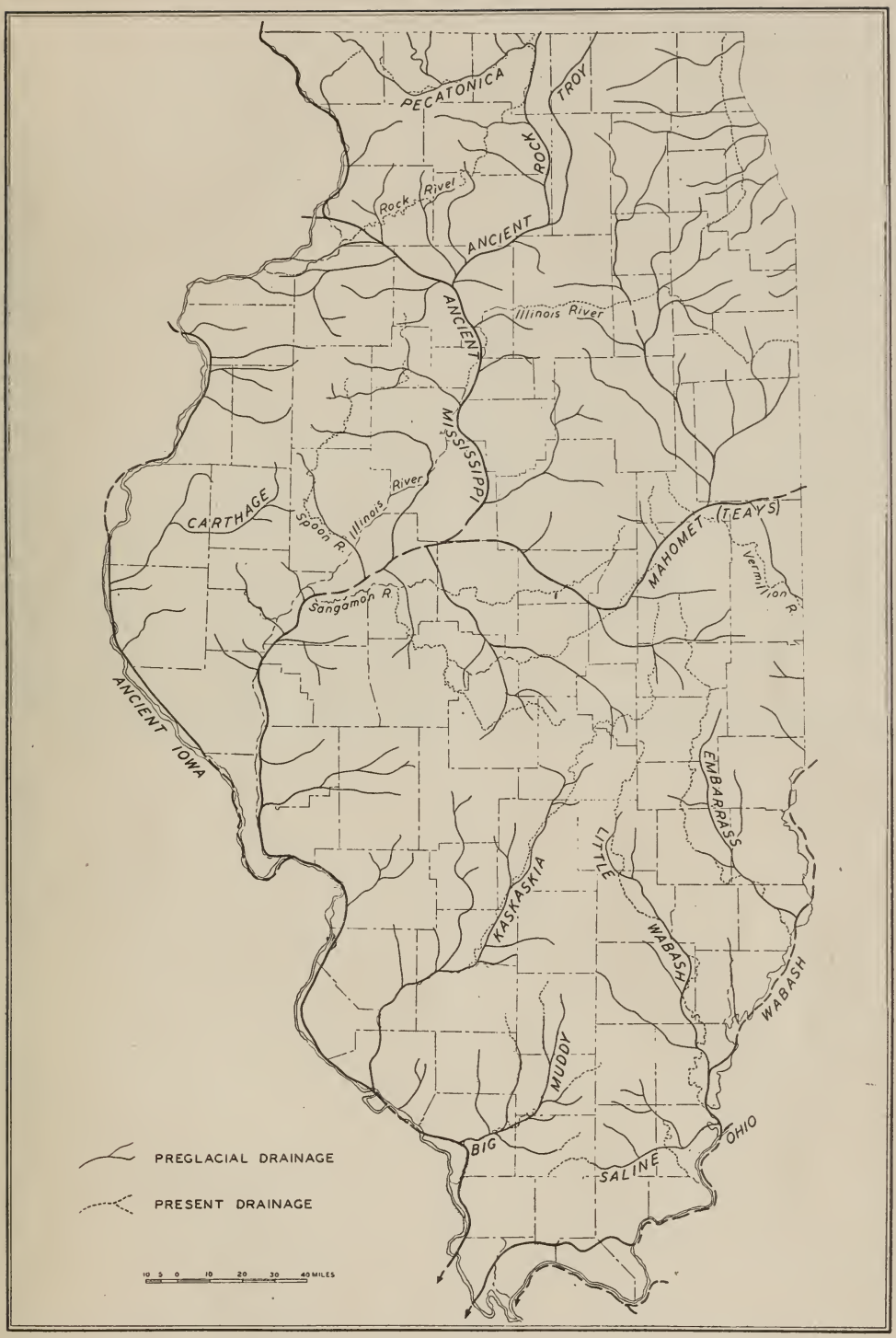

FIG. 5.—Major preglacial drainage systems in Illinois

major preglacial drainage lines were determined. With uplift of the peneplain, the larger streams in many places were established transverse to structure in superimposed valleys or in antecedent valleys on the upwarped peneplain surface. Outstanding transverse valleys in the state include the courses of (1) the ancient Mississippi across the west flank of the Wisconsin arch and Savanna-Sabula anticline in northwestern Illinois, (2) the ancient Rock across the positive element between the Sandwich fault zone and LaSalle anticline in north-central Illinois (Figs. 2 and 5), (3) the ancient Iowa and ancient Mississippi across the Cap au Grés structure in the Calhoun County area of western Illinois, and (4) the ancient Mississippi across the east flank of the Ozark dome in southwestern Illinois.[38]

During the third cycle of erosion which followed, a local peneplain was eroded on the weak beds of the Illinois basin. The extent of the surface to the east and northeast is not known, but to the north and west it is believed to terminate against remnant uplands of the older land surface. The ancestral Mississippi and Mahomet (Teays) were probably the major streams, although their courses may not have been established until the close of the cycle.

During the Havana cycle the main preglacial drainage lines were present and broad valleys were eroded along the ancient Mississippi, Mahomet, Kaskaskia, and Wabash systems. A rejuvenation of drainage initiated the deep-valley stage, which continued until interruption of the cycle by glaciation. This last cycle may have opened with the earth movements at the close of the Tertiary, in which event the main bedrock valleys could have been entrenched during the preglacial Pleistocene.

[38] Considered antecedent to the doming of the Ozark peneplain by R. F. Flint (ftn. 19).